Active Project (2016 - 2016)

1mN Electrospray Thruster with Safe Passive Propellant Delivery, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Busek proposes to develop a compact electrospray propulsion system with unprecedented capability. The <2U system will provide 6U CubeSats with 1000m/s of deltaV at 1.2mN thrust and >1500s Isp while requiring less than 45W of power. Compared with existing state-of-the-art CubeSat thrusters, the system will provide more thrust than available gridded ion engines at lower power and without greatly penalizing Isp. Busek will develop the thruster through new innovations merged with existing, flight-qualified electrospray thruster heritage. The extremely low flow rates of high Isp electrospray thrusters permits passive feeding, where pressure vessels, regulators and their associated electronics are eliminated in favor of a natural flow regulation; freeing up valuable volume budget for additional propellant or payload. However, passive electrospray thrusters in general suffer from flow control ambiguities, leading to irrecoverable failures due to the conductive propellant degrading or shorting electrical isolators. Busek will integrate new innovations that overcome these issues into a systematic development methodology, leading to the most robust passively-fed electrospray thruster to date. The system will be capable of more 0.7kg of propellant throughput (~1000m/s deltaV for a 6U CubeSat) and be fully scalable to higher capacity.In Phase I Busek will develop a thruster head that provides >300microN of thrust and includes a never-saturated porous reservoir. The restorative capillary force of this reservoir will prevent liquid seepage and maintain consistent performance. An annular geometry will circumvent propellant and surface degradation due to edge effects. In parallel, a method for transferring IL from high open volume storage tanks to the intermediate porous reservoir will be demonstrated. Finally, the complete 1.2mN thruster, comprising an array of 4 thruster heads will be designed. Phase II, will validate this system and culminate with delivering an engineering model

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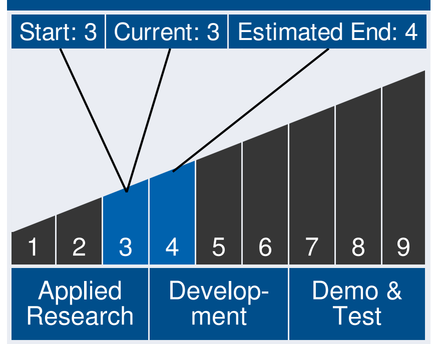
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: NASA's 2015 technology roadmap recognizes the importance of electrospray propulsion to primary propulsion, formation flight and attitude control of small (3U-6U) spacecraft. Specific applications include asteroid scouting missions along with lunar and interplanetary missions. Additionally, the proposed electrospray system is ideal for drag-compensation applications for long term earth observation (EO) missions at altitudes as low as 200km. Furthermore, the technology continues to have numerous applications to scientific spacecraft of all sizes where high precision, low thrust systems permit extremely accurate attitude and station keeping. The latter functionality has been recently demonstrated in-space by Busek's colloid thrusters on the NASA ST7/ESA LISA Pathfinder mission. The highly scalable nature of the technology, both in terms of thrust and deltaV, without loss of performance is a critical feature permitting applicability to this wide spectrum of functions. However, lifetime limitations and scalability to sufficient thrusts are recognized as present gates to reliable realization of CubeSat scale high deltaV systems.Busek has proven both the functional feasibility and lifetime potential of colloidal/electrospray propulsion through the ST7/LISA spacecraft program. Through integrating that heritage and addressing the life-limiting issues of passively fed electrospray thrusters, Busek aims to bring the full potential of electrospray propulsion to 3U/6U spacecraft platforms

To the commercial space industry:

Potential Non-NASA Commercial Applications: Compact propulsion systems that are scalable in both thrust and deltaV without loss of performance are an enabling technology for CubeSat missions and therefore have numerous commercial applications. The market size for the proposed system is accordingly very large. Potential non-NASA customers include commercial asteroid prospecting, DoD and commercial EO

Management Team *(cont.)*

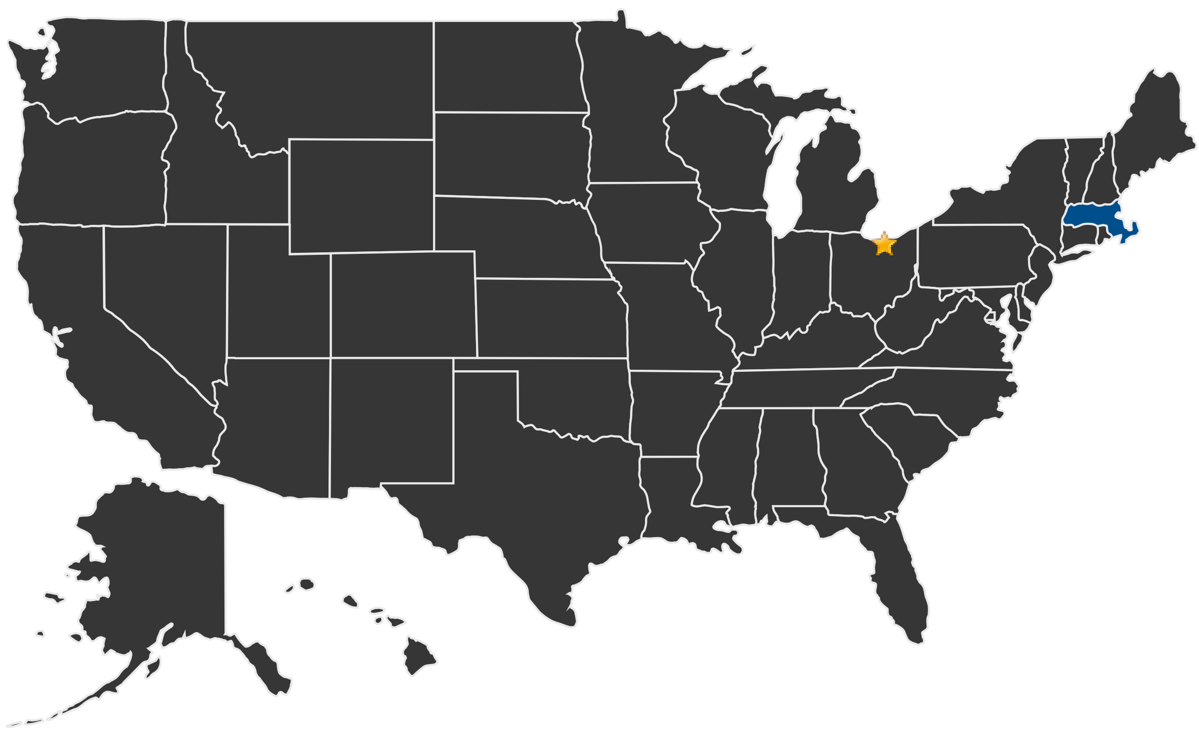
Principal Investigator:
- Nathaniel Demmons

Technology Areas

Primary Technology Area:
In-Space Propulsion Technologies (TA 2)
└─ Non-Chemical Propulsion (TA 2.2)
  └─ Electric Propulsion (TA 2.2.1)

missions. Numerous LEO CubeSat mission durations could be extended through the drag-compensation capabilities of the proposed system. De-orbiting applications are particularly relevant to new LEO telecommunication and EO initiatives. International consensus is forming around the need for orbital debris management, which poses risks to functioning space assets. It is likely that in the near future, international agreements will require provisions in spacecraft design to reposition satellites to disposal orbits, or to completely deorbit them. Safe/unpressurized long-term propellant management and minimal mechanical/moving parts, issues addressed in this project, will be critical to de-orbit applications.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Glenn Research Center

Other Organizations Performing Work:

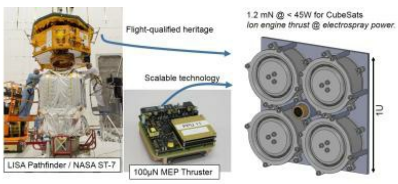
- Busek Company, Inc. (Natick, MA)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23152)

IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

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